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ABSTRACT

This module, designed to help students find and identify various geometric shapes and solids, contains 26 worksheets. Topics covered by these worksheets include: identification and grouping of objects with particular patterns, work with pentagons, hexagons, spirals, and symmetry. Teaching suggestions are included. (MK)

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SE 030 305

ENVIRONMENTAL MODULE FOR USE

IN A

MATHEMATICS LABORATORY SETTING

Geometry in Nature - PATTERNS

by

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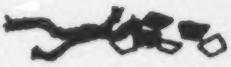
Geometry in Nature - PATTERNS

This module may be used in many ways.

1. It may be used as a complete unit.
2. It may be used in part or in total to supplement other materials you already have.
3. Groups of students may be assigned to various experiments according to past performance.
4. The class may be divided so each group has a leader with the ability to help the other students.
5. You may find some activities appropriate for total class involvement, while others would be better used in individual or small group surroundings.

Materials



Contained in this module:

1. A packet containing transparencies of snowflakes
2. Grid paper
3. Acetate mirrors
4. Folded paper model

Teacher must provide:

1. String
2. Straws (plastic)
3. Paper (unlined)
4. Construction paper

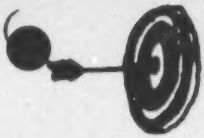
Optional (we can provide):

1. Slide presentation

Optional (teacher provides):

1. Slide projector, screen
2. Microscopes
3. Pond water
4. Leaves, flowers and insects
5. Hand lens

GUIDE



OBJECTIVES

.Given various geometric shapes, students will be able to pick out and identify:

a) Circles
b) Ellipses
c) Triangles
d) Squares
e) Hexagons
f) Pentagons
g) Decagons

.Given various solid geometric shapes, students will be able to pick out and identify:

a) Spheres
b) Ellipsoids
c) Polyhedrons

.Given paper, students will be able to draw or construct an example of symmetry showing the axis of symmetry.

.Students will be able to find examples and identify from nature:

a) Circles
b) Ellipses
c) Triangles
d) Squares
e) Pentagons
f) Hexagons
g) Decagons
h) Spheres
i) Ellipsoids
j) Polyhedrons
k) Symmetry
l) Spirals
m) Cones

.Given a set of nature slides, students will be able to find and identify at least one example of a geometric pattern in each slide.

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OVERVIEW

The module has activities grouped together in the following ways:

In Student Worksheets #1 to 5, students examine, identify and group objects with particular patterns.

Student Worksheets #6, 7, 8 and Eyeopener #2 work with circles.

Student Worksheets #9 and 10 work with pentagons.

Student Worksheets #11 and 12 use the hexagon to work with spirals.

Student Worksheets #13 to 20 are designed to give students background with symmetry.

Student Worksheets #21 to 26 are concerned with tieing the other activities together. These worksheets may be used to help evaluate the unit.

OUTLINE

I. Eyeopener #1 (Optional)

A. Materials supplied:

1. Slides for Eyeopener #1, "Patterns"

B. Materials needed:

1. Slide projector
2. Screen

C. Work to be completed by the student:

1. Observe slides and respond to questions from students and teacher.

D. Teaching suggestions:

1. Show slides

a. In order to create spontaneous responses, show each picture for no more than three seconds.

2. You may want to ask students some questions on what they observed. Some suggested questions are:

a. What did you see in the slides?

b. Was there anything in common between slides?

3. You and your students may want to develop appropriate questions.

4. You may want to rerun the slides after the discussion.

II. Student Worksheets #1 to 5

A. Materials provided:

1. Student Worksheets #1 to 5

B. Materials needed:

1. Square pieces of paper or tagboard
2. Scissors
3. Straws and baggie ties (available from produce department in grocery stores)
4. Paper
5. Microscope (optional)

C. Work to be completed by students:

1. Student Worksheets #1 to 5
2. Might share results with each other

D. Teaching suggestions:

1. You could have the students pick one or more of the activities to do by self or in a group.

2. You may group and assign different worksheets to each group.

3. You could have the whole class doing all the activities.

E. Answers to Student Worksheet #4 are on page 5.

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III. Student Worksheets #6, 7, 8 and Eyeopener #2

A. Materials supplied:

1. Student Worksheets #6, 7, 8 and Eyeopener #2
2. Grid paper

B. Materials needed:

1. Straws and string
2. Microscope (optional)
3. Hand lenses (optional)
4. Pond water (optional).

C. Work to be completed by students:

1. Eyeopener #2
2. Student Worksheets #6, 7 and 8

D. Teaching suggestions:

1. You may want to begin with Eyeopener #2 and pose questions about circles, ellipses and their differences.
2. You could have the whole class work on Student Worksheet #6 and examine their results by breaking into groups and comparing each other's circles.
3. Student Worksheets #7 and 8 are optional. You may want to use Student Worksheet #7 without the hand lens.

IV. Student Worksheets #9 and 10

A. Materials supplied:

1. Student Worksheets #9 and 10
2. Folded paper model

B. Materials needed:

1. Paper (unlined)

C. Work to be completed by students:

1. Student Worksheets #9 and 10

D. Teaching suggestions:

1. You may want to discuss pentagons and show pentagons to them.

2. You could work Student Worksheet #8 above, or in conjunction with Student Worksheet #9.

3. You may want to send students to the library to find pictures of flowers and pentagonal shapes (e.g., Star Jasmine), or animals (starfish, sand dollar.)

4. You may want to take the students on a nature walk in a park or school grounds, where they could try to find appropriate examples.

V. Student Worksheets #11 and 12

A. Materials supplied:

1. Student Worksheets #11 and 12
2. Examples for the worksheets

B. Materials needed:

1. String
2. Straws
3. Pencil
4. Paper (unlined)

C. Work to be completed by the student:

1. Student Worksheets #11 and 12
2. Find spirals in natural order

D. Teaching suggestions:

1. You may want to group students, some working on Student Worksheet #11, others on Student Worksheet #12.

2. You might take the students on a walk (a park or the school grounds) and attempt to find spiral designs.

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3. You may want students to find books from nature showing spirals (e.g., pine cones, snails and sea shells.)

VI. Student Worksheets #13 to 17

A. Materials supplied:

1. Student Worksheets #13 to 17
2. Acetate mirrors

B. Materials needed:

1. Scissors
2. Construction paper
3. Tempera

C. Work to be completed by the student:

1. Student Worksheets #13 to 17
2. Find symmetry in nature

D. Teaching suggestions:

1. You may want the students to pick which one or two of the worksheets are of interest to them.

2. You may want the students to compare symmetry in nature with man-made designs.

E. Answers to Student Worksheets #14 and 17 are on pages TG-5 and 6.

VII. Student Worksheets #18, 19 and 20

A. Materials supplied:

1. Student Worksheets #18, 19 and 20

B. Materials needed:

1. Straightedge

C. Work to be completed by student:

1. Student Worksheets #18, 19 and 20

D. Teaching suggestions:

1. Using the set of transparencies, "snowflakes", begin the class by showing each

transparency approximately three seconds. Students should observe the infinite patterns of snowflakes that nature provides for us.

2. You may have the students point out the various polygons that make up a snowflake.

3. Students might be asked to identify symmetry.

4. Students may also be asked where man has used snowflake patterns in objects he has constructed.

5. Using the mirrors, have students show symmetry.

VIII. Student Worksheets #21 and 22

A. Materials supplied:

1. Student Worksheets #21 and 22
2. Slides, "Patterns in Nature" (Optional)

B. Materials needed:

1. Slide projector (optional)
2. Screen

C. Work to be completed by students:

1. Identify geometric shapes in nature

D. Teaching suggestions:

1. These worksheets might be considered your evaluation of the unit.

2. You may wish to group the students while on the nature walk.

IX. Student Worksheets #23 to 26 and Eyeopener #3

A. Materials supplied:

1. Student Worksheets #23 to 26 and Eye-opener #3

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B. Materials needed:

1. Construction paper
2. Scissors
3. Geoboards and rubber bands

C. Work to be completed by students:

1. Student Worksheets #23 to 26

D. Teaching suggestions:

1. You may want to group the students and let them pick which activities they would like to do.
2. You may group the students, with each group doing a different activity, then have them explain their activity to the other groups.
3. You could have the whole class work on all of the activities.
4. You might use Student Worksheet #26 to lead into another module, People Patterns.
5. You might use Eyeopener #3 to begin these activities, by having whole class discuss survival and adaptation.
6. You might discuss people adaptation and survival with Eyeopener #3 and lead into People Patterns.

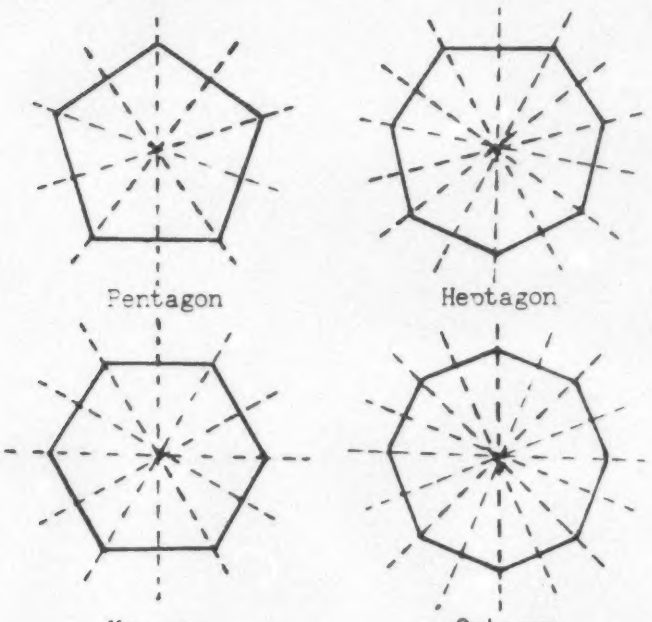
Answers to Student Worksheets #4, 14 and 17

Student Worksheet #4 - Ring Around the Log:

Possible explanations for width of rings would include: the amount of growth that year is indicated by width; wider ring, more growth. The weather affects this growth - dry years would leave a narrow ring, moist years a wider ring.

Other projects might be discovered from this one: What kinds of trees (from ring examination) grow the most per year? What can be done to improve growth? What parts of the world would you expect tree growth to prosper, and why?

Student Worksheet #14 - Axis Again:



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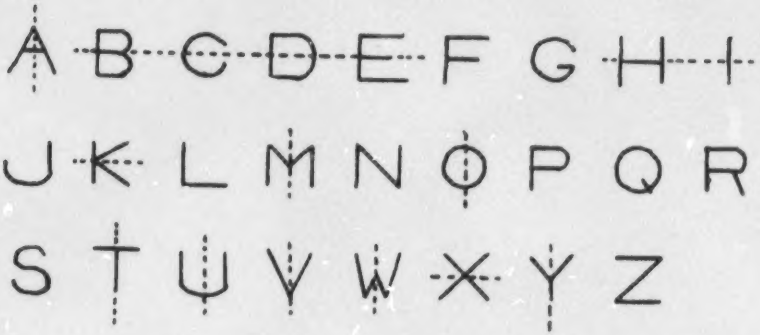
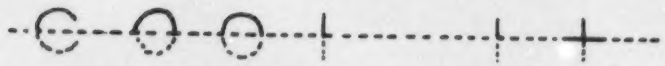
Answers to Student Worksheet #17:





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You will be observing a set of slides in this activity. What does each slide have in common with the other slides? Can you identify any of the slides?

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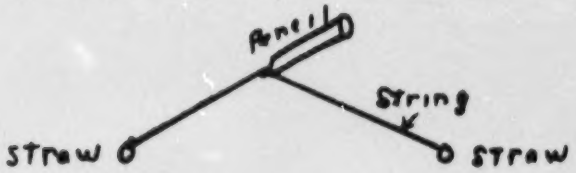
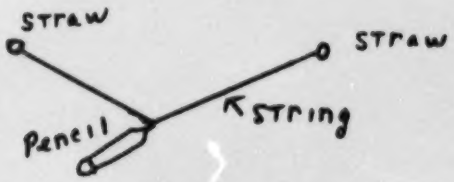
Make a simple compass, using string and a pencil. Tie a straw to both ends of a string. One person should hold both straws on the paper so the string is not tight. The second person takes a pencil and holds it against the string, keeping the string tight; for example,



Rotate the pencil as far to the left and right as possible. (Keep the string tight)

Now, keep the straws in the same place and hold the pencil on the opposite side of the string; for example,



Rotate to the left and right as far as possible. What figure do you have? What happens if you move the straws closer together? What happens if you move the straws farther apart?

Where do you find these designs in nature?

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How does nature use patterns to insure survival of the species for some animals? Can you think of any animals that have patterns that blend with their surroundings? List as many as you can below.

Can you find pictures of animals to show patterns and how the patterns assist survivability?

Animals with patterns that assist survival might include:

Animal	Pattern

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Take a square piece of construction paper. Use a pencil and a straight edge to mark off seven different pieces of any size from the square. Cut the square into the seven pieces you have marked off.

Can you arrange the seven pieces to form a rectangle? a triangle?

Put the seven pieces together to make five different shapes (you may want to make shapes that resemble animals, letters of the alphabet or other designs).

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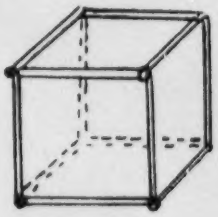
What's Your Baggie?

Using straws and baggie ties to hold the straws together, make as many polyhedrons (solid geometric shapes) as you can. Identify the shapes and component geometric parts when possible.

Example:



Baggie tie

Cube - composed of squares

Sketch	Component Parts

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Rock It

Rocks come in different sizes and shapes. They are made up of different materials. Take 20-30 rocks and group them together. For example: Group 1 may include all rocks shaped like ellipsoids (footballs). Group 2 may be grouped by color. Group 3 may be grouped with flat surfaces.

Find your own reasons for grouping.

Exchange your groups with another student. See if you can find their patterns for grouping, and see if they can find your patterns in grouping. (You may want to jot down the group number and pattern on a piece of paper, so the other group can't accuse you of changing the pattern after they guessed it.)

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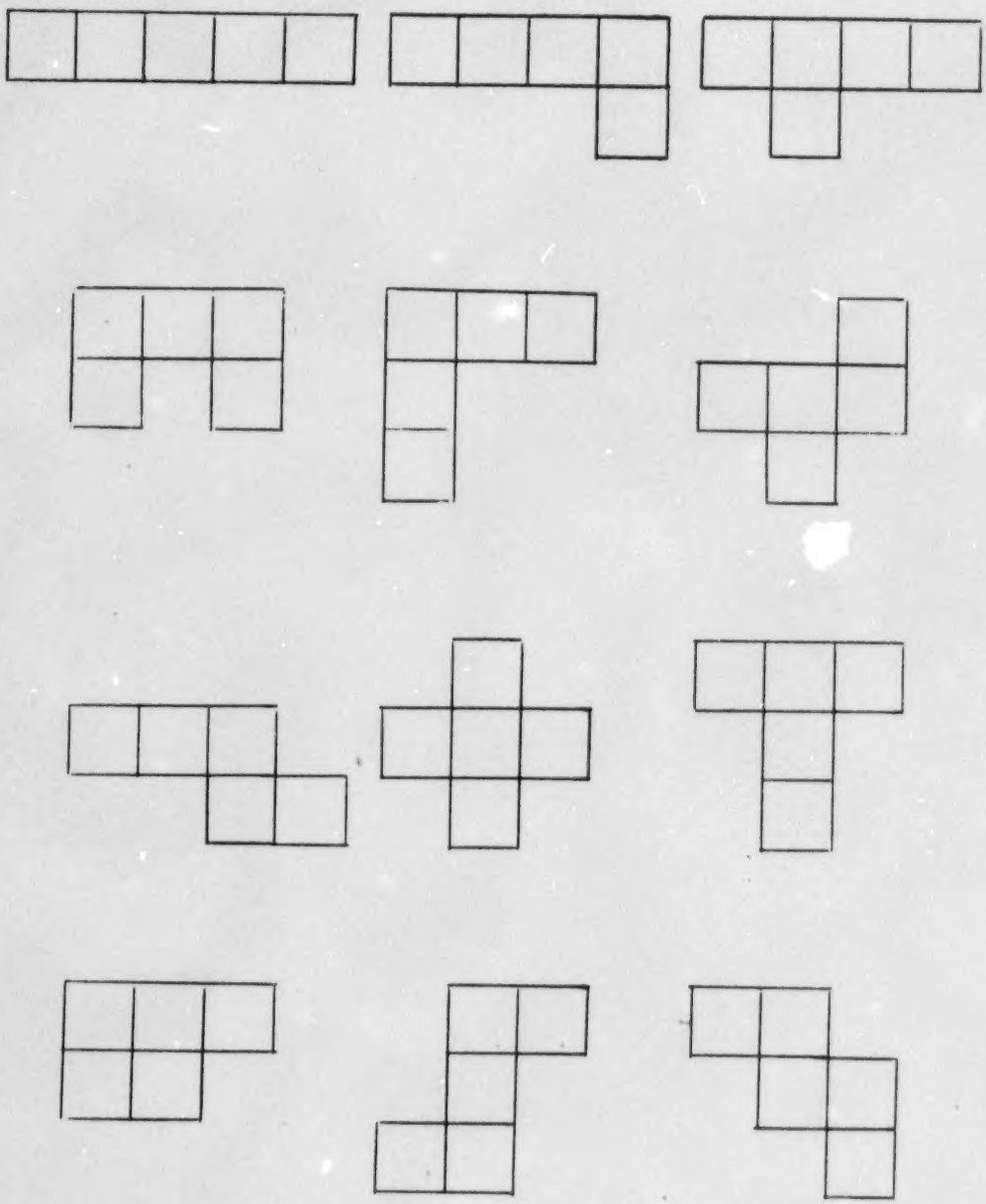
Cut out the following pieces and make a rectangle by placing all pieces together. All pieces must be used.



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Ring Around the Log

Using the picture of a cross section of a log or some cut sections of trees, find as many reasonable explanations to the following questions as you can.

How many rings in this piece?

What does each ring represent?

Are the rings the same widths?

What other patterns can you find in the cross section?

Why are the ring widths the same (or different)?

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Using a microscope and materials (these materials might include leaves, grass and pond water), find as many geometric shapes as you can. Sketch the patterns and label the material observed.

Pattern	Material Observed

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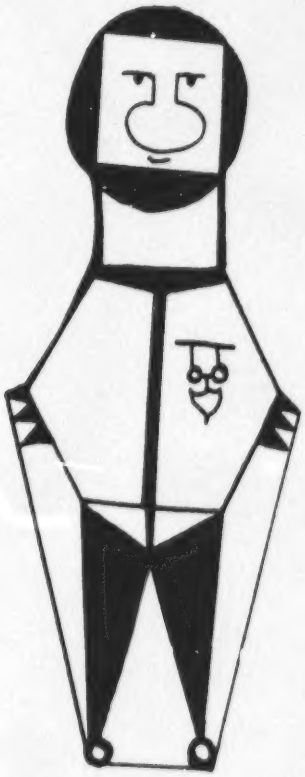
Don't Be A Square

Use the grid paper on Page 6A to make a large circle. Now try to make a circle that covers one-half as much space as your first circle. Can you make another circle that is one-half as big as the last one?



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Using a Bare Eye Moss Likely

Using a hand-lens or the naked eye, look at some moss, lichen on a rock, a patch of the earth, and some wild flowers. Do you see any circles? Sketch the circles you see.

How would you estimate the measurements (diameter and circumference) of the circles you see? You might use a penny or nickel to help you find a way to estimate these measurements. (Compare known diameters with unknown diameters.)

Circle - Sketches

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A Do Drop

Circles exist in places we cannot see with our naked eye. Look at a drop of pond water under a microscope. Do you find living organisms in the form of circles?

Sketch these circles and try to estimate their sizes (diameter or circumference).

Sketch	Material Observed

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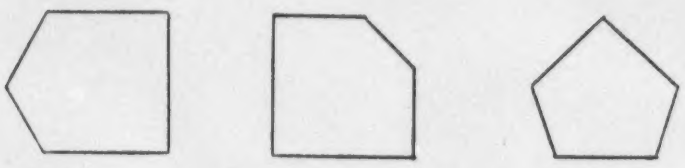
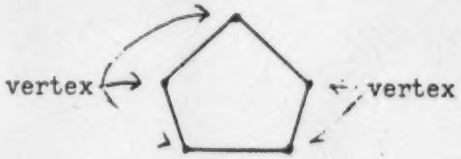
A pentagon is a five-sided figure.

Examples of pentagons:



A regular pentagon is a five-sided figure with the measures of all sides and angles equal. The "corner" is called a vertex.

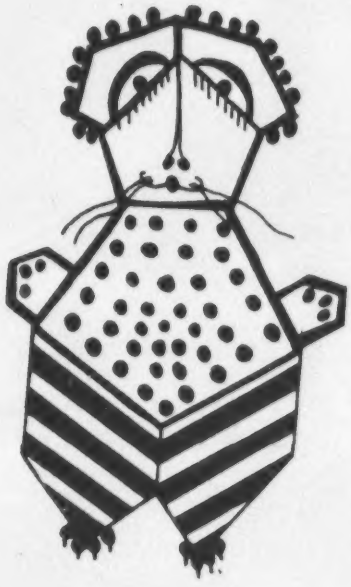


Construct a regular pentagon on a piece of paper.

Draw a line from a vertex to an opposite vertex. Continue by connecting all vertices to their opposite vertices. The star inside is called a pentagram.

You might sketch a flower design, closing the pentagon in the construction of that design.

Can you find pictures of flowers that show examples of pentagons? animals?



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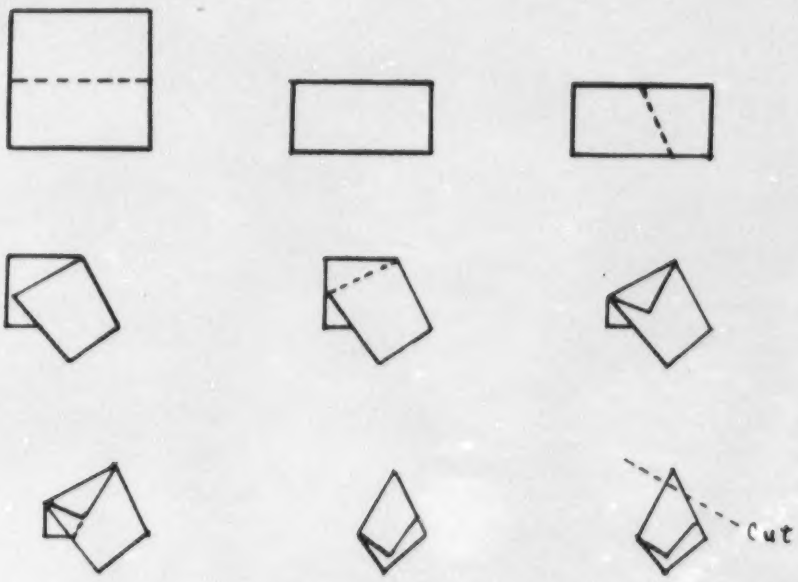
Star Track

A Star made with <u>one</u> cut on rectangular paper (8½" x 11").



Can you make a star using a different size piece of paper?

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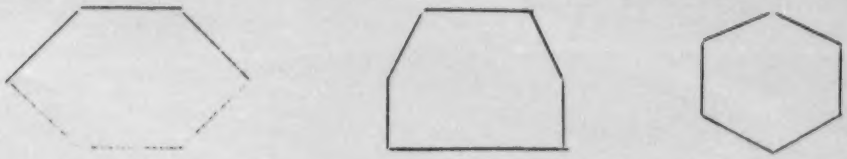
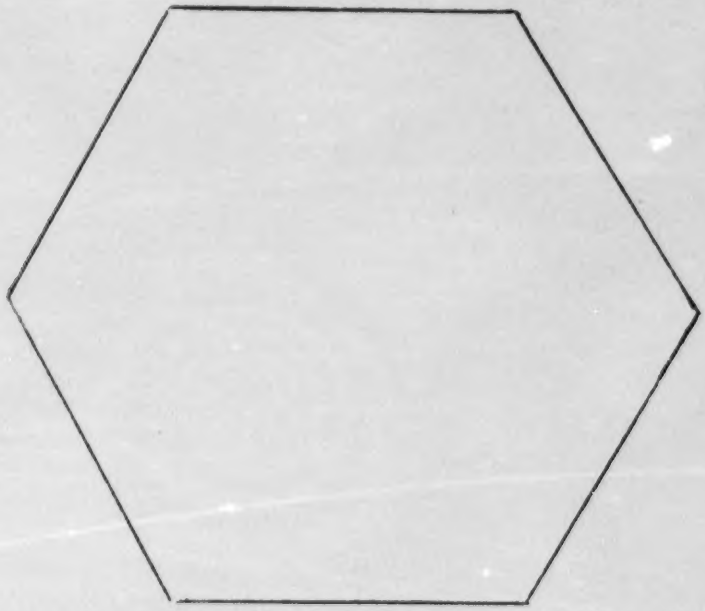
A hexagon is a six-sided figure. Here are some examples:



An equingular (regular) hexagon has all sides and angles equal. An example:



Take a ruler and find the midpoint (center) of each side of the given regular hexagon. Now connect the consecutive midpoints. Draw a line through the center of the hexagon from one midpoint to the midpoint on the opposite side. Do this with all of the midpoints. Next, draw all of the diagonals through the center, (from one vertex to the opposite vertex). You should have a hexagon inscribed in the original hexagon.

The sides of the new hexagon will cross a diagonal. The points of intersection on the new hexagon are its midpoints. Connect the consecutive midpoints. You should have a third hexagon inscribed in the second hexagon. Continue until you have all possible hexagons drawn.

Take each vertex on the largest (original) hexagon and label each of them with an A. Take each of the vertices of the second hexagon and label them with a B. Continue until all of the vertices of all the hexagons are labeled.

Start at any A and draw a line, with a felt tipped pen, to the consecutive B, then from this B to the next consecutive C and so on. The resulting figure is an equiangular logarithmic spiral.

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String Around the Pencil

You will need a piece of string 6 to 12 inches long and two pencils.

Tape the string to a pencil and tape the second pencil to the other end of the string. Next draw a spiral by going around one pencil with the second pencil. Keep the string tight as it unwinds.

What other ways can you find to draw a spiral?

Can you list six different patterns in nature that use or are spirals?

1.

2.

3.

4.

5.

6.

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Axis Again

Fold a piece of paper in half. Make cuts on the side that is not on the fold. Now open the sheet.

Example:

The pattern on the left is the same as the pattern on the right of the fold. This is an example of symmetry. The fold is called the line or axis of symmetry.

Use construction paper and scissors to make several symmetric designs.

Do the designs resemble any familiar objects?

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How many lines of symmetry can you draw in a triangle? in a square?
Example:

How many lines of symmetry can you draw in a pentagon, hexagon, heptagon and octagon?

How many lines of symmetry do you have for the "odd-sided figures"?

How many lines of symmetry do you have for the "even-sided figures"?

Do you see a pattern developing?

Geometric Design	Number of Lines of Symmetry
Pentagon	
Hexagon	
Heptagon	
Octagon	

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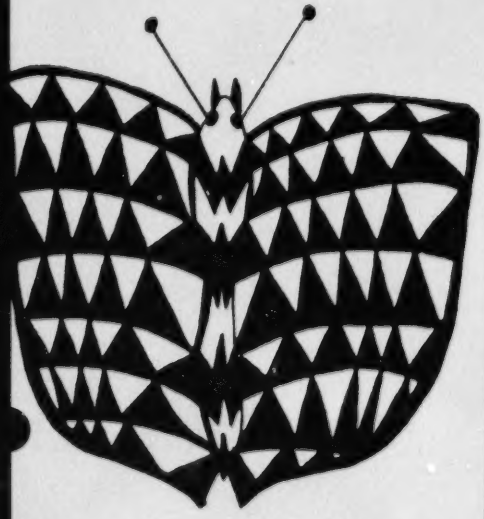
Walk on the Wild Side

While on a nature walk, can you notice any trees that are symmetric, asymmetric (not symmetric)? A nature walk could be considered any walk where you observe the nature around you.

Can you notice any flowers or leaves that are symmetrical, asymmetrical.

Can you sketch these?

Object	Sketch of Nature's Symmetry
1.	
2.	
3.	
4.	
5.	



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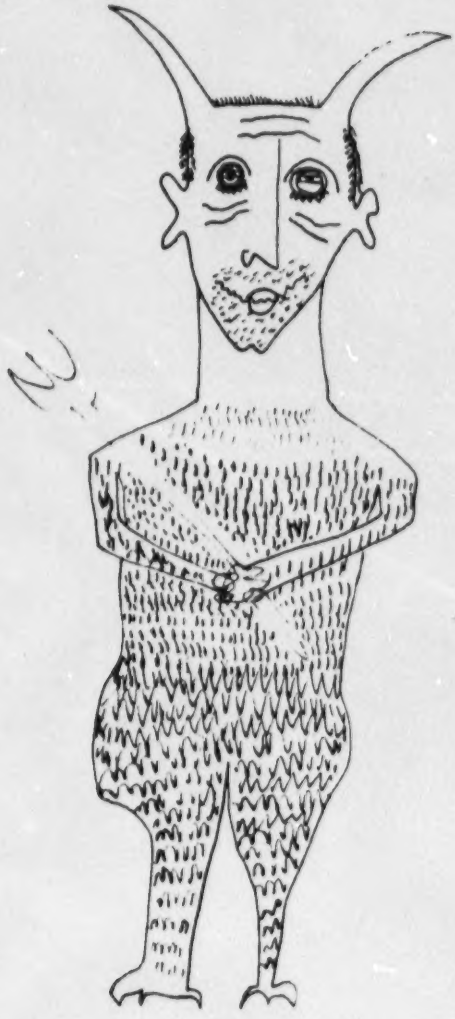
The Devil Made Me Do It

A paint devil is made by folding a piece of paper, opening it and then spattering poster paint (Tempera) at random on the paper. The paper is then folded again. Now it is reopened. You will notice the two halves have identical shapes.

Can you identify any of your patterns?



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Can you find an axis of symmetry, using the acetate mirror for each letter?

Sketch the axis with a broken line on the letters. For example:

Mirror is on the
axis of symmetry (dotted line)

Can you make a message using the mirror and part of the letters? Here is an example:

Exchange messages with your neighbor.

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Flakey Makey

The 'Von Koch' snowflake curve:

Take an equilateral triangle, C_o. Trisect each side and replace the center third of each by two sides of an equilateral triangle described on it outwards, thus obtaining C_1. Trisect C_1 in the same way, obtaining C_2 and so on.

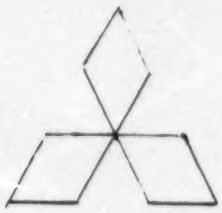
C_o C_1 C_2

Continue with C_3, C_4 and so on.

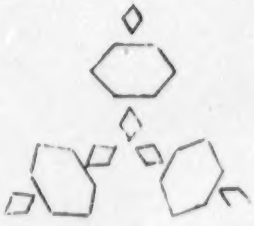
'Nother Flakey Makey

The anti-snowflake curve is obtained as the limit of a sequence similar to the Von Koch snowflake curve; the only difference being that the equilateral triangles are turned inward instead of outward.

C_0



C_1



C_2

Continue with C_3, C_4 ...

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Be a Little Flakey

Since there are infinite patterns of snowflakes, try making some of your own. Sketch below. (You might need a straightedge to help you.)

of DML

While on a walk in your schoolyard, park, or in your own yard, find at least five different geometric patterns in nature. (You have to use natural resources, not man-made designs -- buildings, cards, etc.) Sketch the object below and identify the geometric pattern.

Nature's Object	Geometric Shape

U of DML

"Patterns in Nature"

While viewing the set of slides, "Patterns in Nature", jot down as many geometric shapes as you can find in each slide. You will have only 10-15 seconds per slide.

Slide Number	Geometric Shapes
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

3 U of DML

Geo-Design

Using your geobaord, make as many geometric designs as you can. Describe your design (including balance, shape and symmetry). If you haven't made a symmetric design, make one.

Compare your design with designs of the other students in the class.

Tell what animal, plant, etc. would have this particular design.

Can you make flower or animal designs on your geoboard?

Can you make pentagons, hexagons, etc. on your geoboard?

Make patterns on the geoboard, using only one congruent (all the same size) shape. This is referred to as a tesselation. An example of a tesselation would be a honeycomb constructed from congruent hexagons.

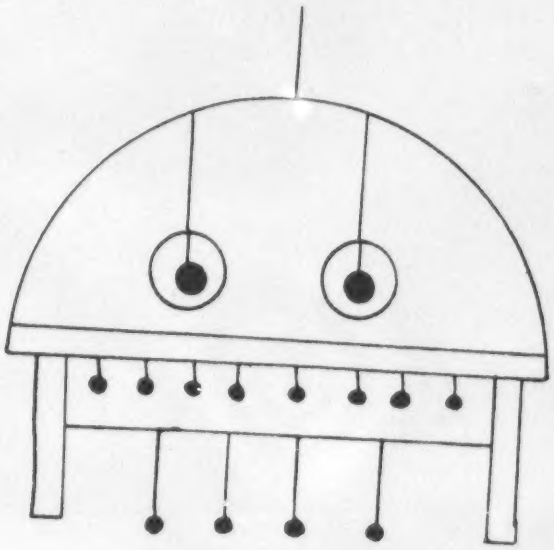
Can you make a tesselation with two shapes?

U of DML

Keep on Trucking

See if you can construct a mobile, using geometric forms. A mobile is a group of objects or shapes hung by string from a central point. An example of a mobile is a set of wind chimes.

You will need construction paper or tagboard, string, scissors, tape and some imagination.



U of DML

Straight Ahead

Walking the straight path is not always the easiest path to follow. Out on the football field or in some large area without many obstacles, try to walk a straight line from one point to another. The catch is that you are blindfolded.

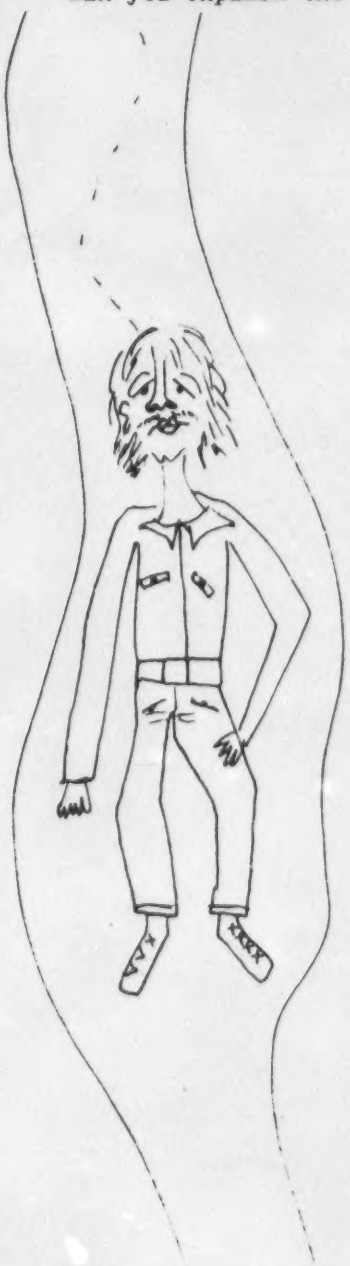
Sketch the results of different people's path below.

Are they straight?

Is there a pattern?

Can you explain the pattern?

Sketch-A-Path



3 U of DML

Find ten different natural objects in your school yard. Rank the nature items according to age (youngest #1, oldest #10).

Can you find a way to predict the age of natural objects?

		Object	Approximate Age
Youngest	1.		
	2.		
	3.		
	4.		
	5.		
	6.		
	7.		
	8.		
	9.		
Oldest	10.		

73 U of DML